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(54) **Polishing peripheral portions of wafers**

(57) A method and apparatus for mirror-polishing a peripheral portion of a wafer (W) carries out a first polishing step (2, 12, 13, 14) for polishing the peripheral portion of the wafer (W) by using tape (T) having abrasive grains thereon, and a second polishing step (3) for thereafter polishing the peripheral portion of the wafer (W) by using a buff (22, 23, 24) with an abrasive material.

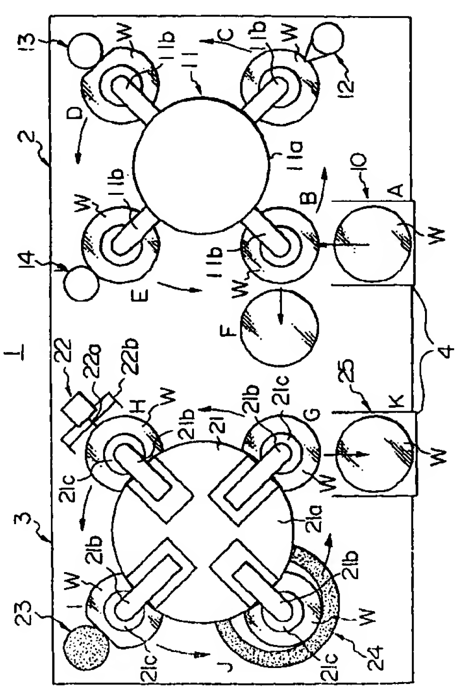

FIG.2

① tape w/ abr. particles

② Buff w/ abrasive.

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Description

The present invention relates to a method for mirror-polishing the peripheral portion of a wafer and an apparatus useful for carrying out the method.

A mirror-polishing step of a wafer is generally carried out, after a chamfering step for preventing the peripheral portion of a wafer from being chipped off, a lapping step for making variation in thickness of wafers small, and an etching step for removing a cracked layer and contaminated portions. The mirror-polishing step of the wafer includes a mirror-polishing step for the main surface of the wafer and a mirror-polishing step for the peripheral portion of the wafer.

The wafer is provided with an orientation flat or a notch at a predetermined position with respect to the crystal orientation of the wafer on the periphery thereof. The orientation flat or the notch portion is utilized for detecting the position on the periphery of the wafer in an automatic manufacturing apparatus. Therefore, also in the mirror polishing step of the peripheral portion of a wafer, it is necessary to mirror-polish both the orientation flat or the notch portion and the other portion (hereinafter, referred to "the periphery").

In a ~~conventional method for mirror-polishing a pe-~~ripheral portion of a wafer, a buff made of a foam resin is used. In the method, the periphery and the orientation flat, of the wafer is mirror-polished by a buff having a groove (a form chamfering groove) which has a section corresponding to the section of the periphery and the orientation flat, of the wafer. In such a mirror-polishing step, an abrasive material comprising an aqueous solution of sodium hydroxide (NaOH) or the like containing very fine $SiO1_2$ powder or the like is used. In order to mirror-polish the notch portion by the method, a disc-shaped buff is used. Also in this case, an abrasive material is used as a matter of course.

By the way, in a general step for etching a silicon single crystal wafer, the so-called acid etching, e.g., an etching in which the wafer was immersed in a liquid mixture of hydrofluoric acid, nitric acid and acetic acid, or the like, was carried out. However, because such an acid etching has defects that it is difficult to keep the flatness of the silicon wafer after lapping and that high costs are required for processing the waste of the used etching liquid, recently, an alkali etching has been mostly used, instead of an acid etching. However, when an alkali etching is utilized, because the rear surface or the periphery of the silicon wafer is roughened, the smoothness of the wafer is degraded and therefore a further processing for the rear surface or the peripheral surface of the wafer is required. In particular, there is a problem that the processing for the peripheral surface of the silicon wafer after an alkali etching requires much time for processing the surface to have a roughness less than a predetermined value, to obtain the target smoothness, which is several times that of an acid etching.

The present invention was developed in view of the above-described problem. An object of the present invention is to provide a mirror-polishing method by which a wafer surface having a satisfactory smoothness can be stably obtained in a processing time shorter than that of a conventional buff-polishing and a mirror-polishing apparatus.

Leading towards the present invention the inventors have investigated a tape-polishing method in which a tape which has abrasive grains on it is used. In the tape-polishing method, the peripheral portion of the wafer is mirror-polished by pressing the portion against a tape provided from a tape supplying reel. The used tape is wound around a tape take-up reel to continuously supply fresh surfaces of the tape to the portion to be processed. The peripheral portion of the wafer is mirror-polished by rotating a drum around which the tape is wound, in order to obtain a sufficient relative speed between the tape and the wafer to polish the periphery of the wafer.

According to their investigation with respect to the buff polishing method and the tape-polishing method, it is found that there are following problems. That is, the buff polishing method requires a processing time several times as much as that of the tape-polishing method, in order to obtain a mirror-polished surface having a roughness less than a predetermined value, and the type of the buff used creates variations in necessary processing time. On the other hand, the tape-polishing method has some inherent limitations in surface finish obtained.

According to a first aspect of this invention a method of mirror-polishing a peripheral portion of a wafer comprises a first polishing step for polishing the peripheral portion of the wafer by using a tape having abrasive grains thereon, and a second polishing step for thereafter polishing the peripheral portion of the wafer by using a buff with an abrasive material.

According to a second aspect of this invention an apparatus for mirror-polishing a peripheral portion of a wafer comprises a first polishing section for polishing the peripheral portion of the wafer by using a tape having abrasive grains thereon, and a second polishing section for thereafter polishing the peripheral portion of the wafer by using a buff with an abrasive material.

By using both tape-polishing and buff polishing in order, that is, to polish the peripheral portion of the wafer by using a tape having abrasive grains thereon, and thereafter to polish the peripheral portion by using a buff with an abrasive material it has been found that a wafer surface having a roughness less than a predetermined value can be stably obtained in a processing time shorter than that of buff-polishing alone.

FIG. 1 is for comparing the tape-polishing method with the buff-polishing method. In this figure, the smoothness is entered into the vertical axis and the polishing time is entered into the horizontal axis. It is found the following points from FIG. 1. The tape-polishing method requires shorter polishing time to obtain a mir-

ror-polished surface having a predetermined smoothness, however, the method has some limitations in surface finish obtained. The buff-polishing method requires much polishing time to obtain a mirror-polished surface having a predetermined smoothness and creates variations in necessary processing time due to the buff used, however, the method can provide a smoother surface than the tape-polishing method. In FIG. 1, as the characteristic lines according to the tape-polishing methods are more apart from the origin toward the right, the size of abrasive grains held on the used tape is the smaller.

The method according to the present invention can be applied for various kinds of semiconductor wafers, e. g., silicon wafers, compound semiconductor wafers, or the like.

According to the present invention, because a tape-polishing providing a polishing speed larger than that of buff-polishing is carried out before polishing the peripheral portion of the wafer by using a buff, the polishing time necessary to obtain a mirror-polished surface with a predetermined smoothness can be shortened. Further, because the buff polishing which enables finer polishing in comparison with the tape-polishing is carried out after the peripheral portion of the wafer was polished to some extent by the tape-polishing, it is possible to obtain a mirror-polished surface with a high smoothness.

Preferably, the first polishing step comprises a first notch or orientation flat polishing step for polishing a notch or orientation flat portion which is formed in the peripheral portion of the wafer, by using a tape having abrasive grains thereon, and a first periphery polishing step for mainly polishing a peripheral portion of the wafer other than the notch or orientation flat portion by using a tape having abrasive grains thereon; and the second polishing step comprises a second notch or orientation flat polishing step for polishing the notch or orientation flat portion by using a buff, and a second periphery polishing step for mainly polishing the peripheral portion of the wafer other than the notch or orientation flat portion by using a buff. The first notch polishing step may be carried out by pressing a portion of the tape having abrasive grains thereon, which can be moved relatively to the notch portion, by a tape supporting member. The first periphery polishing step may be carried out by pressing a portion of a tape having abrasive grains thereon, which is wound around the periphery of a rotary drum and can be moved relatively to the peripheral portion of the wafer, against the peripheral portion of the wafer.

Preferably, the wafer is swung around the centre thereof within a predetermined small angle, during at least one of the first and second notch polishing steps. Accordingly, it is possible to uniformly polish not only the bottom surface but the whole surfaces of the notch portion.

The tape may be swung approximately around an axis which passes through the contact point of the tape and the peripheral portion of the wafer and is parallel to the main surface of the wafer, relatively to the wafer, within a predetermined angle during the first polishing step. According to such a method, it is possible to polish all over the peripheral chamfered portion on the upper and lower surfaces of the wafer.

The second notch polishing step is preferably carried out by pressing a disc-shaped buff against the notch portion of the wafer, while supplying an abrasive material. The second orientation flat polishing step may be carried out by pressing a column-shaped rotating buff having a form chamfering groove which receives the orientation flat portion of the wafer, against the orientation flat portion. The second periphery polishing step is preferably carried out by pressing a cylindrical rotating buff having a form chamfering groove which receives the peripheral portion of the wafer, in the inner peripheral surface of the cylindrical buff, against the peripheral portion of the wafer.

Preferably, the wafer is a silicon single crystal wafer and an alkali etching is carried out to the wafer having a chamfered periphery, prior to the first polishing step. Accordingly, it is possible not only to obtain a mirror-polished surface with a high smoothness in a shorter processing time but also to keep the flatness of the silicon wafer after lapping and to reduce the cost for processing the waste of the used etching liquid.

With the apparatus in accordance with this invention, it is possible not only to carry out both tape-polishing and buff-polishing but also to carry out only one of tape-polishing and buff-polishing as the need arises. When both tape-polishing and buff-polishing are carried out, a wafer surface having a roughness less than a predetermined value can be stably obtained in a processing time shorter than that of buff-polishing.

A preferred example of the present invention will now be described with reference to the accompanying drawings, in which:-

FIG. 1 is a diagram showing the relationship between the smoothness and the polishing time, according to tape-polishing and buff-polishing in the present invention;

FIG. 2 is a plan view of a mirror-polishing apparatus according to an embodiment of the present invention;

FIG. 3 is a plan view of a wafer with a notch portion;

FIG. 4 is a plan view of a wafer with an orientation flat;

FIG. 5 is a side view of a loader in a tape-polishing section in the embodiment;

FIG. 6 is a perspective view of a portion of a wafer transfer device in the polishing apparatus according to the embodiment;

FIG. 7 is a perspective view of a notch polishing part in the tape-polishing section in the embodiment;

FIG. 8 is a perspective view of an orientation flat polishing part or a periphery polishing part in the

tape-polishing section;

FIG. 9 is a side view of an orientation flat polishing part in the buff-polishing section in the embodiment;

FIG. 10 is a perspective view of a periphery polishing part in the buff-polishing section in the embodiment; and

FIG. 11 is a side view of an unloader in the buff-polishing section in the embodiment.

FIG. 2 shows an apparatus for mirror-polishing a peripheral portion of a wafer according to an embodiment of the present invention. The apparatus 1 for mirror-polishing comprises a first polishing section, i.e., a tape-polishing section 2 which can carry out tape-polishing to the peripheral portion of the wafer and a second polishing section, i.e., a buff-polishing section 3 which can carry out buff-polishing to the peripheral portion.

In this embodiment, in a case of mirror-polishing silicon wafers, prior to the mirror-polishing step, a chamfering step for preventing the peripheral portion of the wafer from being chipped off, a lapping step for making variation in thickness of wafers small, and an alkali etching for removing a cracked layer or contaminated portions, were carried out to the silicon wafer. Therefore, the flatness of the silicon wafer after lapping can be easily kept and the cost required for processing the waste of the used etching liquid is low, in comparison with use of an acid etching.

The tape-polishing section 2 comprises a cassette attaching part A to which a cassette 4 containing a lot of stacked wafers W is attached, a first wafer positioning part B for positioning a wafer W, as shown in FIG. 3 or FIG. 4, which was taken out of the cassette 4 one by one, a first notch polishing part C for polishing a notch portion N of the wafer W as shown in FIG. 3,a first orientation flat polishing part D for polishing an orientation flat portion O of the wafer W as shown in FIG. 4, and a first periphery polishing part E for polishing the peripheral portion of the wafer W. In the tape-polishing section 2, a loader 10 is provided in the cassette attaching part A, and a first wafer transfer device 11 is provided at the centre of the tape-polishing section 2. A first notch polishing device 12, a first orientation flat polishing device 13, and a first periphery polishing device 14 are provided in the notch polishing part C, the orientation flat polishing part D, and the periphery polishing part E, respectively.

The loader 10 comprises a lifting device which is not shown, for lifting up or down the cassette 4 which can hold a lot of wafers W in a stacked state therein, and a belt conveyor 10a for taking a wafer W out of the cassette 4 one by one. The loader 10 has a structure in which the wafer W at the bottom position is taken out of the cassette 4 by the belt conveyor 10a in turn.

The first wafer transfer device 11 comprises a rotary body 11a which is driven by a motor which is not shown, to rotate around a vertical central axis, and four arms 11b which are disposed on the rotary body 11a, as shown in FIGS. 2 and 6. Each of the arms 11b can be outwardly extruded by an air cylinder which is not shown and is provided inside the rotary body 11a with a predetermined force, in a predetermined timing. An absorption disc 11c for holding a wafer on the lower surface thereof by vacuum-suction, is provided on the lower portion of the top end of each arm 11b, as shown in FIG. 6. Each absorption disc 11c is communicated with a vacuum pump which is not shown, through an air pipe which is not shown and is provided inside the arm 11b and the rotary body 11a. The absorption disc 11c can be reversibly rotated on the central axis thereof by a motor 11d.

The notch polishing device 12 comprises a rotary drum 30a, and a tape supporting member 30b, as shown in FIG.7. Inside the rotary drum 30a, a tape supplying reel for supplying a tape T for polishing and a take-up reel for taking up the tape T, which are not shown, are provided. The tape T comprises a tape base member and very fine abrasive grains, e.g., SiO_2 powder, or the like, adhered thereon through adhesives, although it is not shown in Figures. As a tape T, it is also possible to use one in which a coating containing very fine abrasive grains is coated on the tape base member. The tape T supplied from the tape supplying reel is once introduced to the outside of the rotary drum 30a and is thereafter wound around the periphery of the rotary drum 30a in helical fashion. The wound tape T is put on the tape supporting member 30b which is provided outside the rotary drum 30a, on the way. The top end of the tape T is then introduced into the inside of the rotary drum 30a and is wound around the take-up reel. The rotary drum 30a can be reciprocally rotated by a motor 30c, and the take-up reel which is not shown, can be driven to rotate by a motor 30d. In the notch polishing device 12, the portion of the tape T which is put on the tape supporting member 30b is pressed against the notch portion N of the wafer W and is thereafter wound around the take-up reel by the motor 30d while reciprocally rotating the rotary drum 30a by the motor 30c. Consequently, the notch portion N of the wafer W is polished by the tape T. During such a polishing, it is preferable to reciprocally rotate the absorption disc 11c on the central axis thereof within a predetermined small angle so that not only the bottom surface---but also the side surfaces of the notch portion N can be polished. Preferably, the rotary drum 30a and the tape supporting member 30b can be relatively moved in a direction in which these can come near or separate from the notch portion N. Further, the rotary drum 30a and the tape supporting member 30b can be reciprocally swung around a horizontal axis which passes through the contact portion of the tape T and the notch portion N and is perpendicular to the above moving direction of the rotary drum. Instead of the swing of the rotary drum 30a and the tape supporting member 30b, the wafer W may be also swung around the axis. Accordingly, it is possible to polish not only the bottom surface but also the upper and lower chamfered surfaces in the notch portion N. For example, a prior U.S. Patent Application

No. 08/567,162 by the present inventor et al. concretely discloses embodiments of such a rotary drum and of a swinging mechanism of the wafer in detail which can be used for the invention.

Each of the orientation flat polishing device 13 and the periphery polishing device 14 has a structure similar to that of the notch polishing device 12. Each of them comprises a rotary drum 40a, as shown in FIG. 8. Inside the rotary drum 40a, a tape supplying reel for supplying a tape T having very fine abrasive grains, e.g., SiO_2 powder, or the like thereon and a take-up reel for taking up the tape T, which are not shown, are provided. The tape T supplied from the tape supplying reel is once introduced to the outside of the rotary drum 40a and is wound around the periphery of the rotary drum 40a in helical fashion. The top end of the tape T is then introduced into the inside of the rotary drum 40a and is wound around the take-up reel. The rotary drum 40a can be reciprocally rotated by a motor 40c. The take-up reel which is not shown can be driven to rotate by a motor 40d. In the orientation flat polishing device 13 and the periphery polishing device 14, the tape T wound around the rotary drum 40a is pressed against the orientation flat O and the periphery of the wafer W and is wound around the take-up reel by the motor 40d while reciprocally rotating the rotary drum 40a by the motor 40c, so that the orientation flat O and the periphery of the wafer W are polished by the tape T. Preferably, the rotary drum 40a can be reciprocally swung around a horizontal axis which passes through the contact portion of the tape T with the orientation flat O or with the periphery of the wafer and is perpendicular to the moving direction of the drum 40a, relatively to the wafer W. Accordingly, it is possible to polish not only the side surfaces of the orientation flat O and of the periphery of the wafer W but also the upper and lower chamfered surfaces thereof.

In the wafer positioning part B, centring for a wafer W is carried out by a positioning device which is not shown. After the tape-polishing steps are completed, the wafer W returned back to the wafer positioning part B is transferred to a delivery part F of the wafer W by a member which is not shown, without being positioned again.

The buff-polishing section 3, i.e., the second polishing section, comprises a second wafer positioning part G for positioning the wafer W, as shown in FIG. 3 or FIG. 4, transferred from the delivery part F by a member which is not shown, a second notch polishing part H for polishing the notch portion N of the wafer W shown in FIG. 3, a second orientation flat polishing part I for polishing the orientation flat O of the wafer W shown in FIG. 4, a periphery polishing part J for polishing the peripheral portion of the wafer W, and a second cassette attaching part K to which a cassette 4 for putting wafers W therein is attached. In the buff-polishing section 3, a second wafer transfer device 21 is provided at the centre of the buff-polishing section 3. A second notch polishing device 22, a second orientation flat polishing device 23, and a second periphery polishing device 24 are provided at the second notch polishing part H, the second orientation flat polishing part I, and the second periphery polishing part J, respectively. The second cassette attaching part K is provided with an unloader 25.

The second wafer transfer device 21 has a structure similar to that of the first wafer transfer device 11. The second wafer transfer device 21 comprises a rotary body 21a which is driven by a motor (not shown) to rotate about a vertical central axis, and four arms 21b which are disposed on the rotary body 21a, as shown in FIG. 2. Each of the arms 21b is outwardly extruded by an air cylinder (not shown) which is provided inside the rotary body 21a with a predetermined force, in a predetermined timing. On the lower portion of the top end of each arm 21b, an absorption disc 21c is provided. Each absorption disc 21c is communicated with a vacuum pump which is not shown, through an air pipe (not shown) which is provided inside the arm 21b and the rotary body 21a. The absorption disc 21c can be reversibly rotated on the central axis thereof by a motor which is not shown.

The second notch polishing device 22 comprises a disc-shaped buff 22a made of a foam resin or the like, having a rotary shaft which is supported by an arm 22b having a "U" shape in plan, as shown in FIG. 2. In this notch polishing device 22, the buff 22a is driven to rotate by a motor which is not shown. The periphery of the rotating buff 22a is entered into the notch of the wafer W and is pressed against the notch portion N, while supplying an abrasive material comprising an aqueous solution of sodium hydroxide (NaOH) or the like containing very fine SiO_2 powder or the like, to the contacting surface of the buff. Consequently, the notch portion N of the wafer W is polished by the rotating buff 22a. During such a polishing, the absorption disc 21c with a wafer W thereon is swung around the central axis thereof within a predetermined small angle so that not only the bottom surface but also the side surfaces of the notch portion N can be polished.

The second orientation flat polishing device 23 comprises a column-shaped buff 23a made of a foam resin or the like, as shown in FIG. 9. On a peripheral surface of the buff 23a, a buff groove 23b of the so-called a form chamfering buff groove, for receiving the orientation flat O of a wafer W is formed. The buff 23a can be driven to rotate on the central axis thereof by a motor 23c and can be transferred up and down by a lifting device which is not shown. The orientation flat O of the wafer W can be polished by pressing the inner surface of the buff groove 23b of the buff 23a against the orientation flat O of the wafer W, while supplying an abrasive material comprising an aqueous solution of sodium hydroxide (NaOH) or the like containing very fine SiO_2 powder or the like, to the contacting surface of the buff.

The second periphery polishing device 24 comprises a cylindrical buff 24a made of a foam resin, as shown in FIG. 10. On an inner peripheral surface of the buff

24a, a buff groove 24b of the so-called a form chamfering buff groove, for receiving mainly the peripheral portion of the wafer W other than the orientation flat portion O, is formed. The buff 24a can be driven to rotate on the central axis thereof by a motor 24c and can be transferred up and down by a lifting device which is not shown. The peripheral portion of the wafer W can be polished by pressing the peripheral portion other than the orientation flat portion O of the wafer W against the inner surface of the buff groove 24b of the buff 24a, while supplying an abrasive material comprising an aqueous solution of sodium hydroxide (NaOH) or the like containing very fine SiO_2 powder or the like, into the buff groove 24b.

The unloader 25 comprises a lifting device (not shown) for lifting up or down the cassette 4 which can hold a lot of wafers W in a stacked state therein, and a belt conveyor 25a for putting wafers W into the cassette 4 one by one. The unloader 25 has a structure in which the wafers W can be put into the cassette 4 one by one by the belt conveyor 25a and lifted up step by step.

In the second wafer positioning portion G, centring for wafers W are carried out by a positioning device which is not shown.

As described above, in the method for mirror-polishing a peripheral portion of a wafer according to the present invention, first, the peripheral portion of the wafer is polished by using a tape having abrasive grains thereon, and is thereafter polished by using a buff with an abrasive material.

Therefore, as shown in FIG. 1, because a tape-polishing providing a polishing speed larger than that of buff-polishing is carried out before polishing the peripheral portion of the wafer by using a buff, the polishing time necessary to obtain a mirror-polished surface with a predetermined smoothness can be shortened. Further, because the buff-polishing which enables finer polishing in comparison with the tape-polishing is carried out after the peripheral portion of the wafer was polished to some extent by the tape-polishing, it is possible to obtain a mirror-polished surface with a high smoothness.

According to the mirror-polishing apparatus having such a structure, it is possible not only to carry out both tapepolishing and buff-polishing but also to carry out only one of tape-polishing and buff-polishing as the need arises. When both tape-polishing and buff-polishing are carried out, a wafer surface having a roughness less than a predetermined value can be stably obtained in a processing time shorter than that of buff-polishing.

Claims

1. A method for mirror-polishing a peripheral portion of a wafer comprising;

   a first polishing step for polishing the peripheral portion of the wafer by using a tape having abrasive grains thereon, and
   a second polishing step for thereafter polishing the peripheral portion of the wafer by using a buff with an abrasive material.

2. A method for mirror-polishing as claimed in claim 1, wherein the tape is swung approximately around an axis which passes through the contact point of the tape and the peripheral portion of the wafer and is parallel to the main surface of the wafer, relatively to the wafer, within a predetermined angle during the first polishing step.

3. A method for mirror-polishing as claimed in claim 1 or 2, wherein the wafer is a silicon single crystal wafer and an alkali etching is carried out to the wafer having a chamfered periphery, prior to the first polishing step.

4. A method for mirror-polishing as claimed in any preceding claim, wherein the first polishing step comprises a first notch or orientation flat polishing step for polishing a notch portion which is formed in the peripheral portion of the wafer, by using a tape having abrasive grains thereon, and a first periphery polishing step for mainly polishing a peripheral portion of the wafer other than the notch portion by using a tape having abrasive grains thereon; and the second polishing step comprises a second notch or orientation flat polishing step for polishing the notch portion or orientation flat by using a buff, and a second periphery polishing step for mainly polishing the peripheral portion of the wafer other than the notch portion by using a buff.

5. A method for mirror-polishing as claimed in claim 4; wherein the first notch polishing step is carried out by pressing a portion of the tape having abrasive grains thereon, which can be moved relatively to the notch portion, by a tape supporting member.

6. A method for mirror-polishing as claimed in claims 4 or 5, wherein the wafer is swung around the centre thereof within a predetermined small angle, during at least one of the first and second notch polishing steps.

7. A method for mirror-polishing as claimed in claims 4, 5 or 6, wherein the second notch polishing step is carried out by pressing a disc-shaped buff against the notch portion of the wafer, while supplying an abrasive material.

8. A method for mirror-polishing as claimed in claim 4, wherein the second orientation flat polishing step is carried out by pressing a column-shaped rotating buff having a form chamfering groove which re-

ceives the orientation flat portion of the wafer, against the orientation flat portion.

9. A method for mirror-polishing as claimed in any of claims 4 to 8, wherein the first periphery polishing step is carried out by pressing a portion of a tape having abrasive grains thereon, which is wound around the periphery of a rotary drum and can be moved relatively to the peripheral portion of the wafer, against the peripheral portion of the wafer.

10. A method for mirror-polishing as claimed in any one of claim 4 to 9, wherein the second periphery polishing step is carried out by pressing a cylindrical rotating buff having a form chamfering groove which receives the peripheral portion of the wafer, in the inner peripheral surface of the cylindrical buff, against the peripheral portion of the wafer.

11. An apparatus for mirror-polishing a peripheral portion of a wafer comprising; a first polishing section for polishing the peripheral portion of the wafer by using a tape having abrasive grains thereon, and a second polishing section for thereafter polishing the peripheral portion of the wafer by using a buff with an abrasive material.

12. An apparatus for mirror-polishing as claimed in claim 11, wherein the first polishing section further comprises a mechanism so that the tape can be swung approximately around an axis which passes through the contact point of the tape and the peripheral portion of the wafer and is parallel to the main surface of the wafer, within a predetermined angle.

13. An apparatus for mirror-polishing as claimed in claim 11 or 12, wherein the first polishing section further comprises a first wafer positioning part for positioning a wafer which was taken out of a container containing a lot of wafers one by one.

14. An apparatus for mirror-polishing as claimed in claim 11 or 13, wherein the first polishing section comprises a first notch and/or orientation flat polishing part for polishing a notch portion and/or orientation flat which is formed in a peripheral portion of the wafer, by using a tape having abrasive grains thereon, and a first periphery polishing part for mainly polishing a peripheral portion of the wafer other than the notch portion or orientation flat by using a tape having abrasive grains thereon; and the second polishing part comprises a second notch and/or orientation flat polishing part for polishing the notch portion and/or orientation flat by using a buff, and a second periphery polishing part for mainly polishing the peripheral portion of the wafer other than the notch portion-or orientation flat by using a buff.

15. An apparatus for mirror-polishing as claimed in claim 14 wherein the first notch polishing part comprises a rotary drum around which the tape having abrasive grains thereon is wound, for giving a motion in a peripheral direction to the tape, and a tape supporting member for holding a portion of the tape thereon and for pressing the held portion of the tape against the notch portion of the wafer.

16. An apparatus for mirror-polishing as claimed in claim 14 or 15, wherein the wafer can be swung around the centre thereof within a predetermined small angle, while the wafer is polished by at least one of the first and second notch polishing parts.

17. An apparatus for mirror-polishing as claimed in claim 13, 14, 15 or 16, wherein the first periphery polishing part comprises a rotary drum around which the tape having abrasive grains thereon is wound, for giving a motion in a peripheral direction to the tape.

18. An apparatus for mirror-polishing as claimed in claim 14, 15, 16 or 17, wherein the second notch polishing part comprises a mechanism for pressing a disc-shaped buff against the notch portion of the wafer, while supplying an abrasive material.

19. An apparatus for mirror-polishing as claimed in any of claims 14 to 18, wherein the second orientation flat polishing part comprises a mechanism for pressing a column-shaped rotating buff having a form chamfering groove which receives the orientation flat portion of the wafer, against the orientation flat portion.

20. An apparatus for mirror-polishing as claimed in any of claims 11 to 19, wherein the second periphery polishing part comprises a mechanism for pressing a cylindrical rotating buff having a form chamfering groove which receives the peripheral portion of the wafer, in the inner peripheral surface of the cylindrical buff, against the peripheral portion of the wafer.

FIG.1

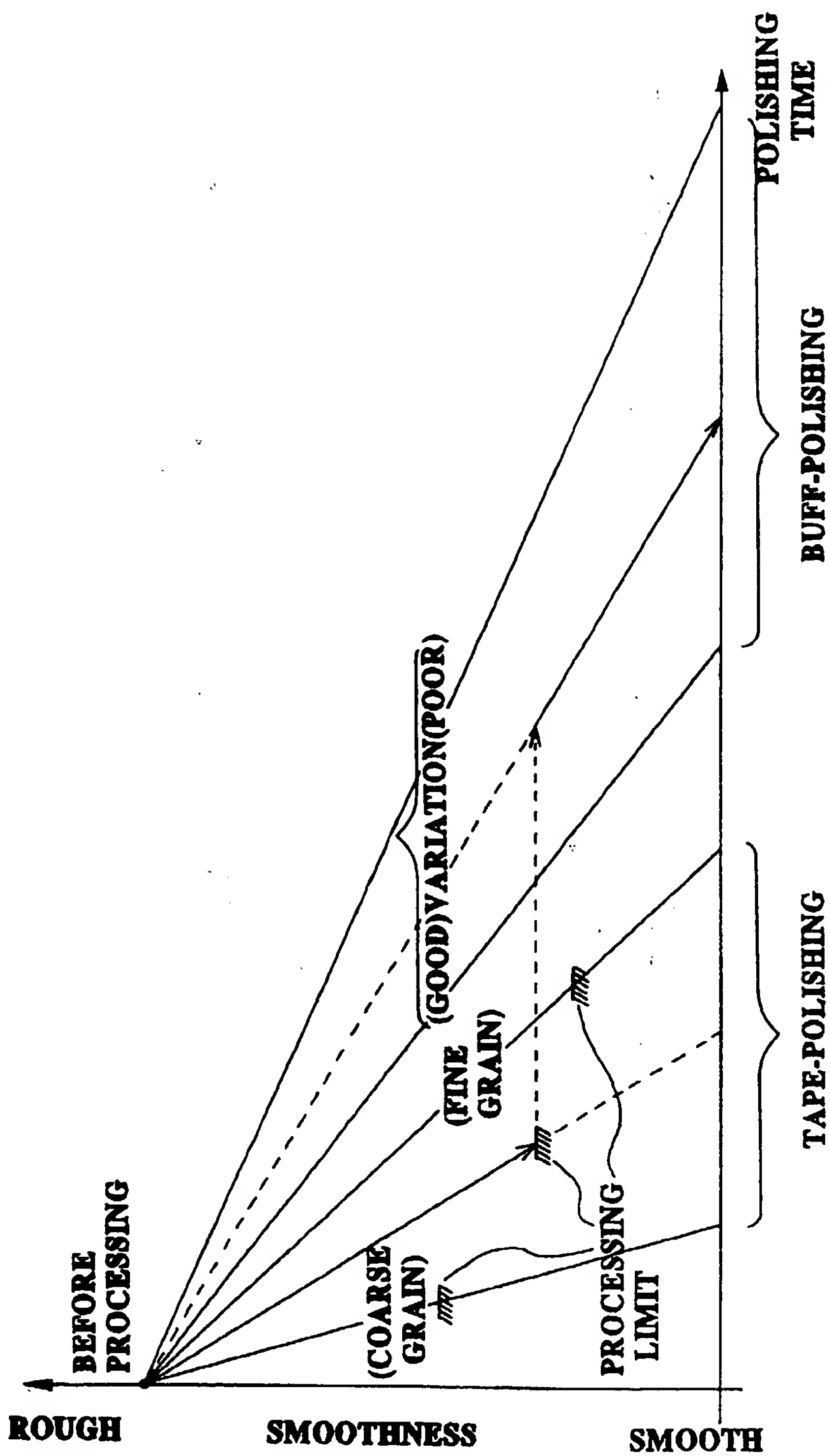
POLISHING TIME
BUFF-POLISHING
TAPE-POLISHING
(GOOD) VARIATION (POOR)
(FINE GRAIN)
(COARSE GRAIN)
PROCESSING LIMIT
BEFORE PROCESSING
ROUGH
SMOOTHNESS
SMOOTH

FIG.2

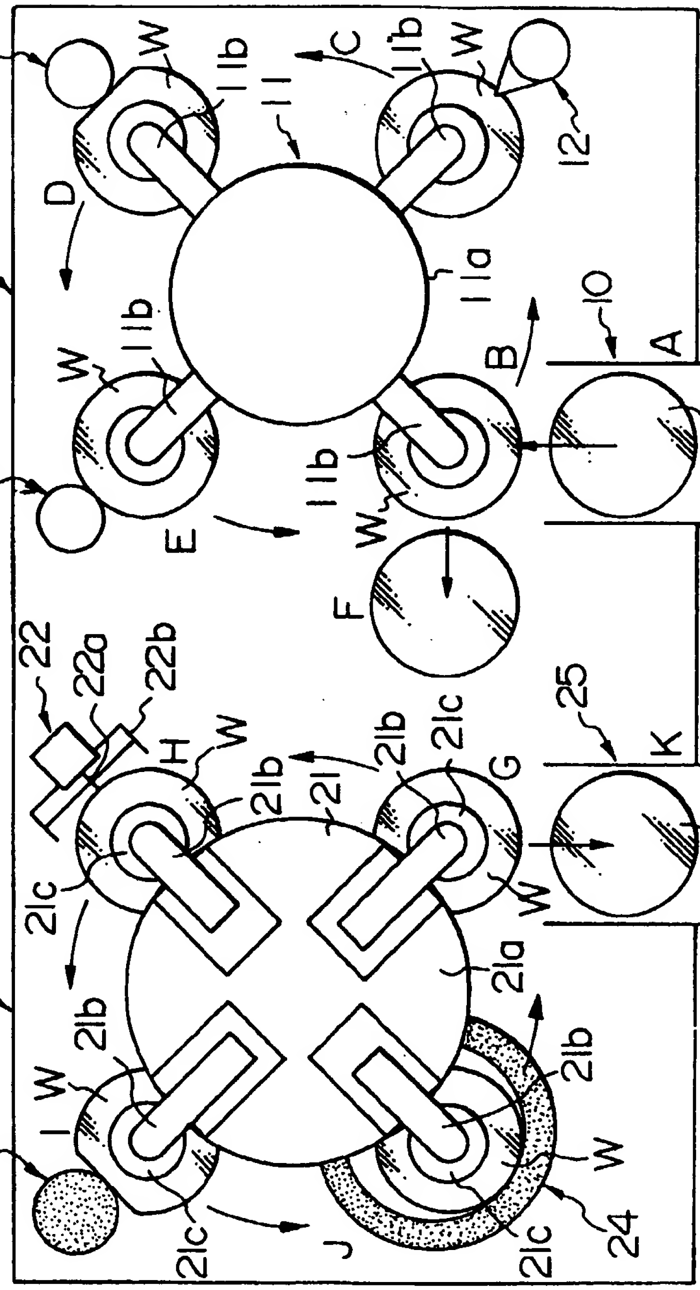
1
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FIG.3

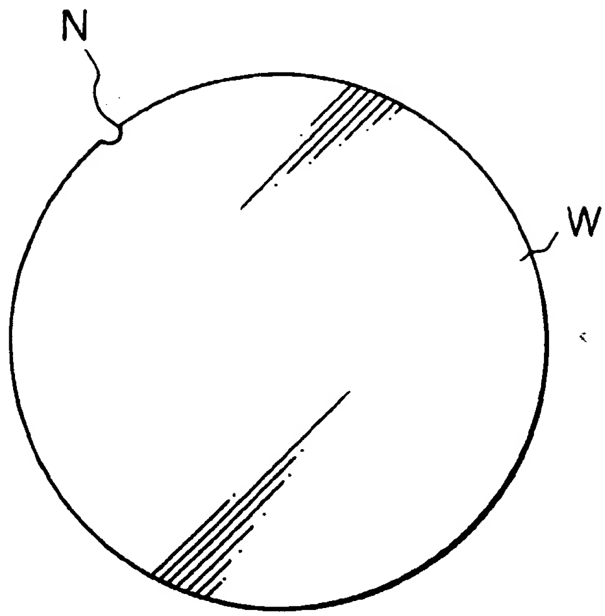


FIG.4

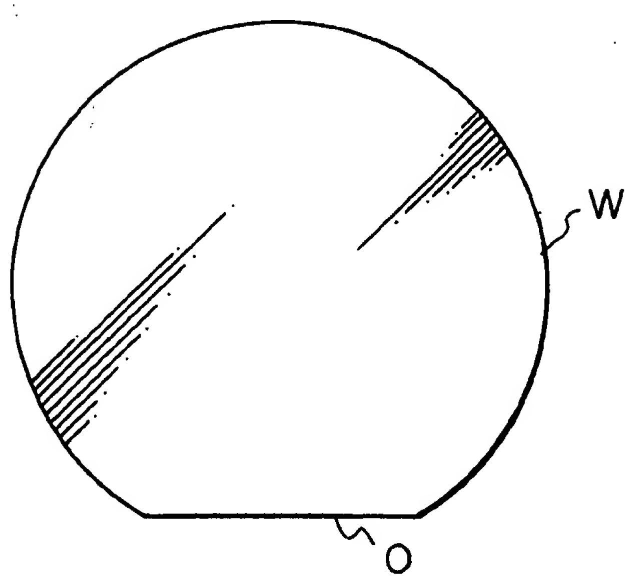


FIG.5

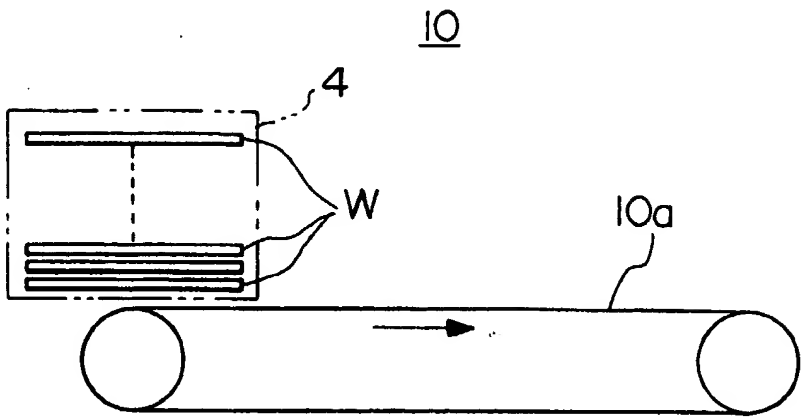


FIG.6

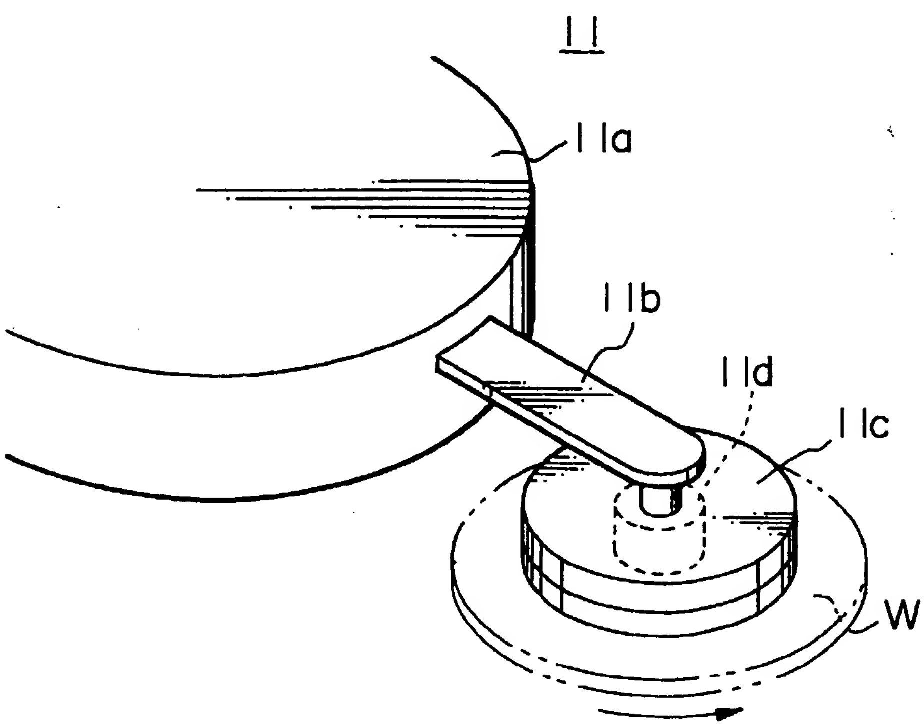


FIG.7

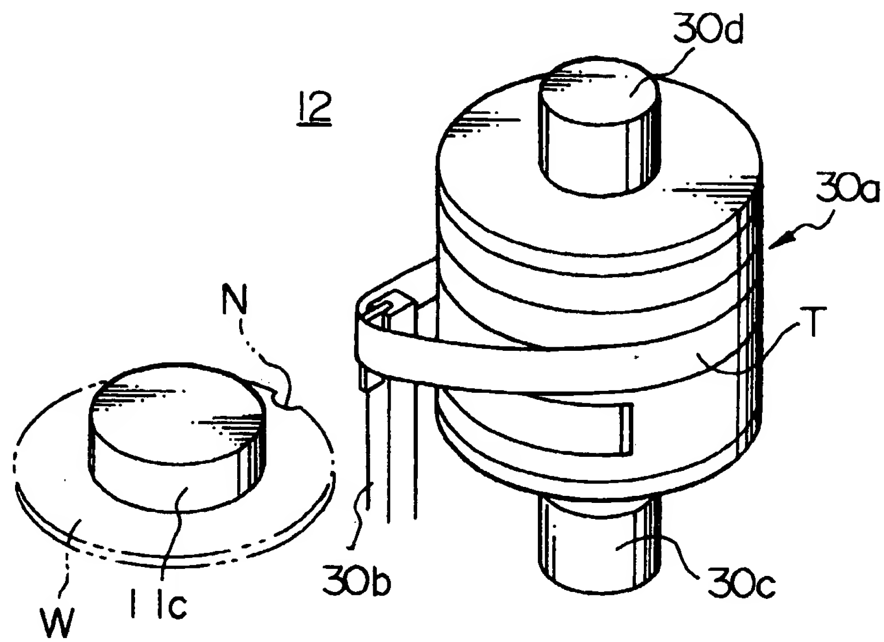


FIG.8

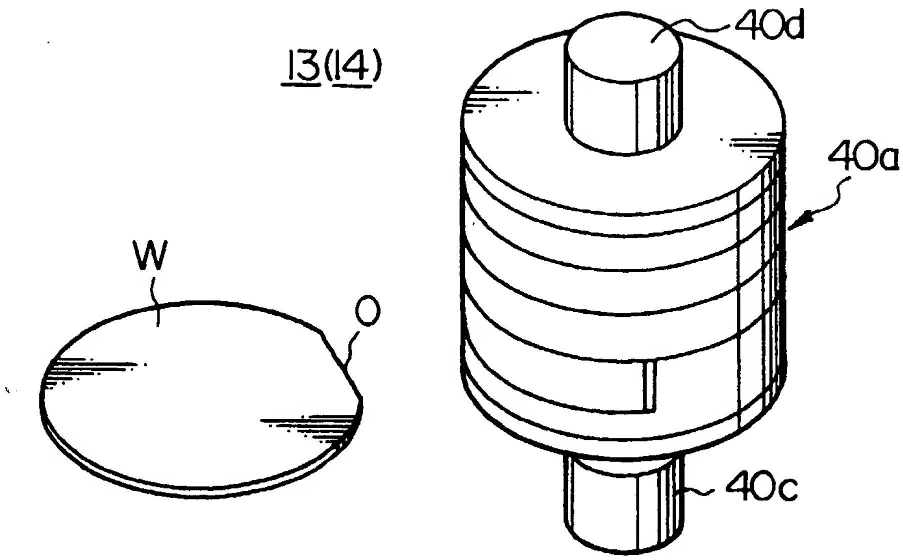


FIG.9

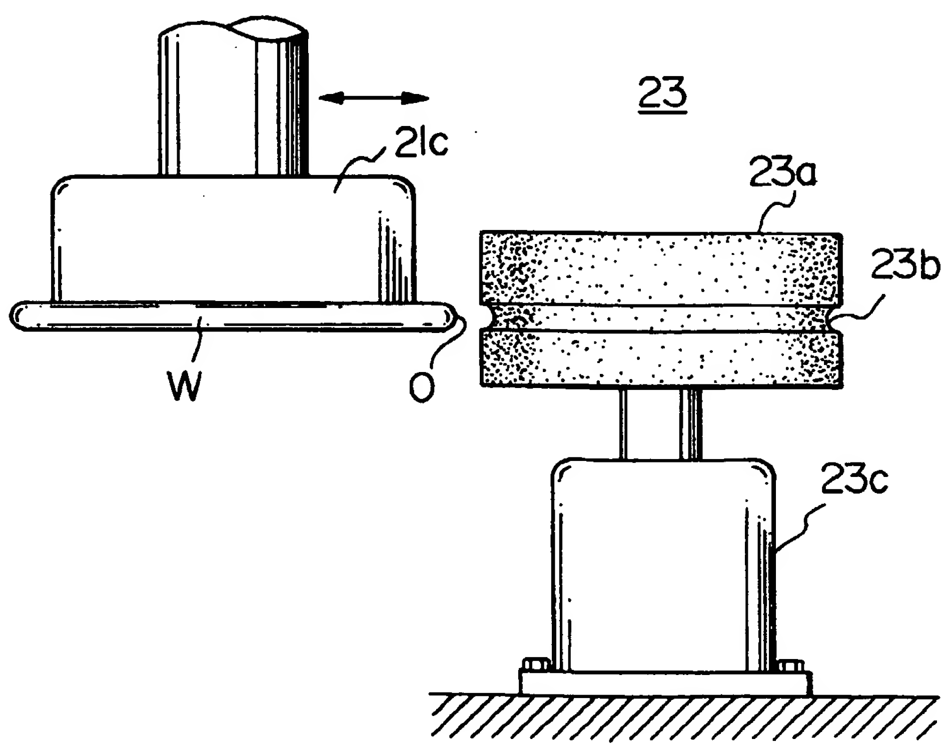


FIG.10

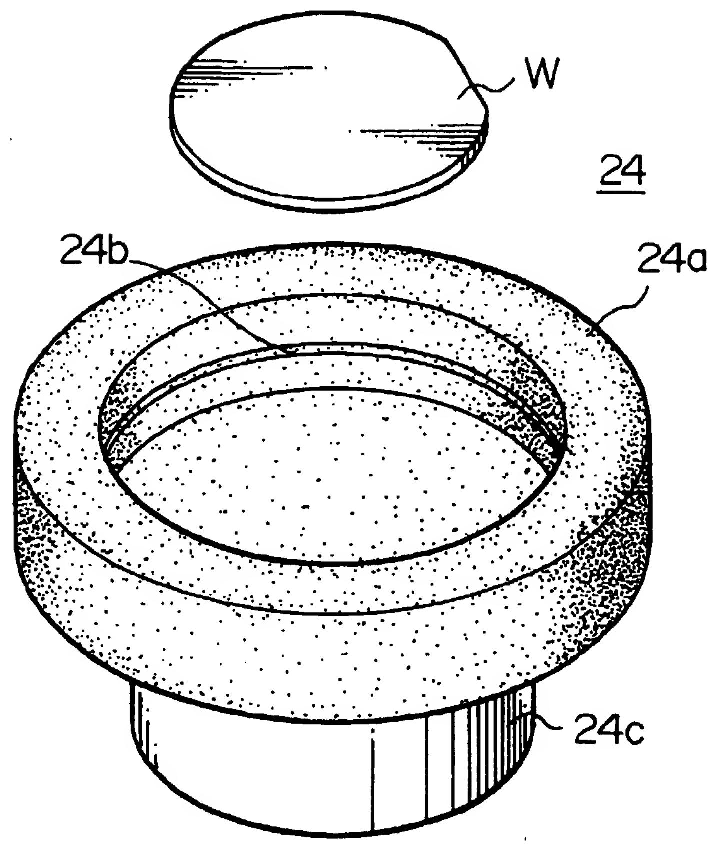
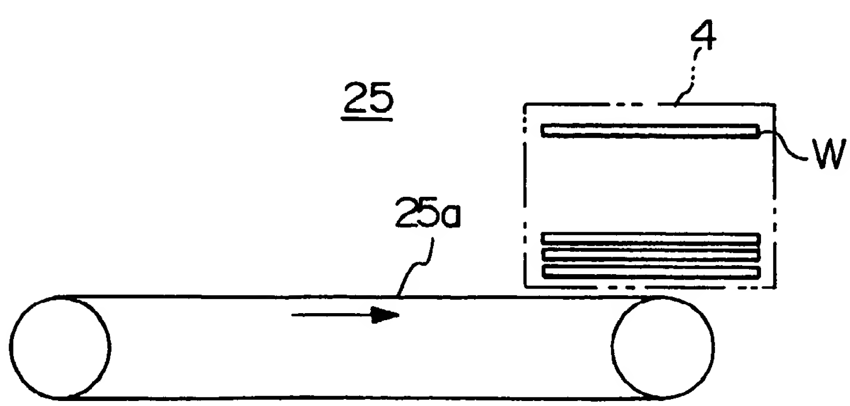


FIG.11



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EP 96 30 3484

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	EP-A-0 646 436 (SHIN-ETSU HANDOTAI COMPANY LIMITED ET AL.) * abstract; figure 1 *	1-4,8, 10,11, 13,14, 18-20	B24B9/06
Y	EP-A-0 584 905 (SHIN-ETSU HANDOTAI COMPANY LIMITED) * abstract; figures 4-7 *	1-4,8, 10,11, 13,14, 18-20	
T	EP-A-0 720 891 (SHIN-ETSU HANDOTAI COMPANY LIMITED ET AL.) * abstract; figures 1,6,7 *	1-3,11, 12	
A	PATENT ABSTRACTS OF JAPAN vol. 7, no. 29 (M-191), 5 February 1983 & JP-A-57 184662 (HITACHI SEISAKUSHO KK), 13 November 1982, * abstract *	1-3,9, 11,12	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A,P	PATENT ABSTRACTS OF JAPAN vol. 95, no. 10, 30 November 1995 & JP-A-07 171749 (SHIN ETSU HANDOTAI CO LTD ET AL.), 11 July 1995, * abstract *	1-3,9, 11,12, 16,17	B24B
A	EP-A-0 650 804 (SHIN-ETSU HANDOTAI COMPANY LIMITED ET AL.) * abstract; figure 1 *	1-8,11, 14,15	
A	EP-A-0 633 097 (SHIN-ETSU HANDOTAI COMPANY LIMITED ET AL.) * abstract; figures 1,3-5 *	1-8,11, 14,18-20	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	28 August 1996	Cuny, J-M

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